Talley Defense Systems and U.S. Navy Thermobaric Warhead Development Program

NDIA Symposium

April 15, 2004

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Presentation Outline

- Background
- Program Goals
- TDS Technical Approach
  - Baseline vs Alternative Designs
  - Analytical Modeling
  - Static and Dynamic Testing
    - Warhead/Fuze Testing
    - All-Up-Round Testing
  - Demonstration Testing

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Shoulder Launched Weapons - Joint Effort by NSWC/IHDIV and TDS

- Technical Challenge
  - Maximize small warhead effectiveness
- Return
  - Increased lethality and incapacitation

- Objective
  - Advance technology in NE compositions and warhead designs for shoulder launched applications.
- Approach
  - IHD to define and test higher performance TB explosive fills
  - TDS to define and test penetrating warhead designs
  - Demonstrate the concept warhead package
- User
  - U.S. and Foreign military forces involved in MOUT operations

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Program Goals

Talley Defense Systems

- Determine the Best Warhead Method for Deploying the Solid Thermobaric Fill
- Warhead Integration Will Include Static Characterization of the Preliminary Designs
- Dynamic Demonstration of One Design With the Required Support Hardware & Data Acquisition and Analysis Tools

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Designs

- System Design Goals
  - Hard/Soft Target Discriminating Warhead
  - No User Adjustments Required
- Performance Goals
  - Aerodynamically Stable Flight
  - Maintain Probability of Hit (P_{hit}) at 150 meters
- Product Improvement vs New Weapon
  - Utilize Existing Production Platform
  - Minimize user impact

System Design Goals

- Small Caliber, Lightweight Weapon
  - Maintain Small Carry Length, Low Weight
  - Maintain Operational Simplicity
  - Maintain Reliability and Lethality
  - Maintain Cost Effectiveness
- Defeat MOUT Target Scenarios
  - Light to Medium Commercial Structures
  - Brick Clad Structures
  - Non-Military and Lightly Armored Vehicles

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Performance Considerations

- Minimum Performance Requirements Set
  - P_{hit} = 0.5 at 150 meters
  - NATO standard target (2.3 m x 2.3 m)
- Establishes Limit to Practical Payload Weight
- Weight and Velocity Combination Defines Penetration Capability

Weapon

- Utilizes Existing Launch Platform
  - Maximizes Use of Existing Components
  - Minimizes Development of New Components
- Minimizes Impact to User
  - Transparent - Operationally Equivalent
  - Only Requires Modification to QE tables

Designs

Existing System Characteristics		
Model	M72 LAW	M72-LAW-NE
Caliber	66 mm	66 mm
Carry Weight	8 lb	<10 lb
Carry Length	31 in	31 in
Extended Length	38.5 in	38.5 in
Range Units	1.6	1.0
Warhead Designed to Defeat	Heavy/Light armor, urban walls	MOUT targets, E&T bunker, light armor

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Target Materials

- Target Material Properties and Analysis
  - Sand
  - Concrete
  - Solid Clay Brick
    - Compression Testing Confined
    - Compression Testing Unconfined
  - Wood

Analytical Modeling

- Warhead Performance
  - Mode of Entry - Through Brick/Plywood Sheeting
    - Collected Material Properties Data
  - Impact and Penetration Analysis
    - Could Minimum Velocity Penetrate Wall Target?
  - Case capabilities
    - Would Warhead Assembly Stay Intact?

Analytical Modeling

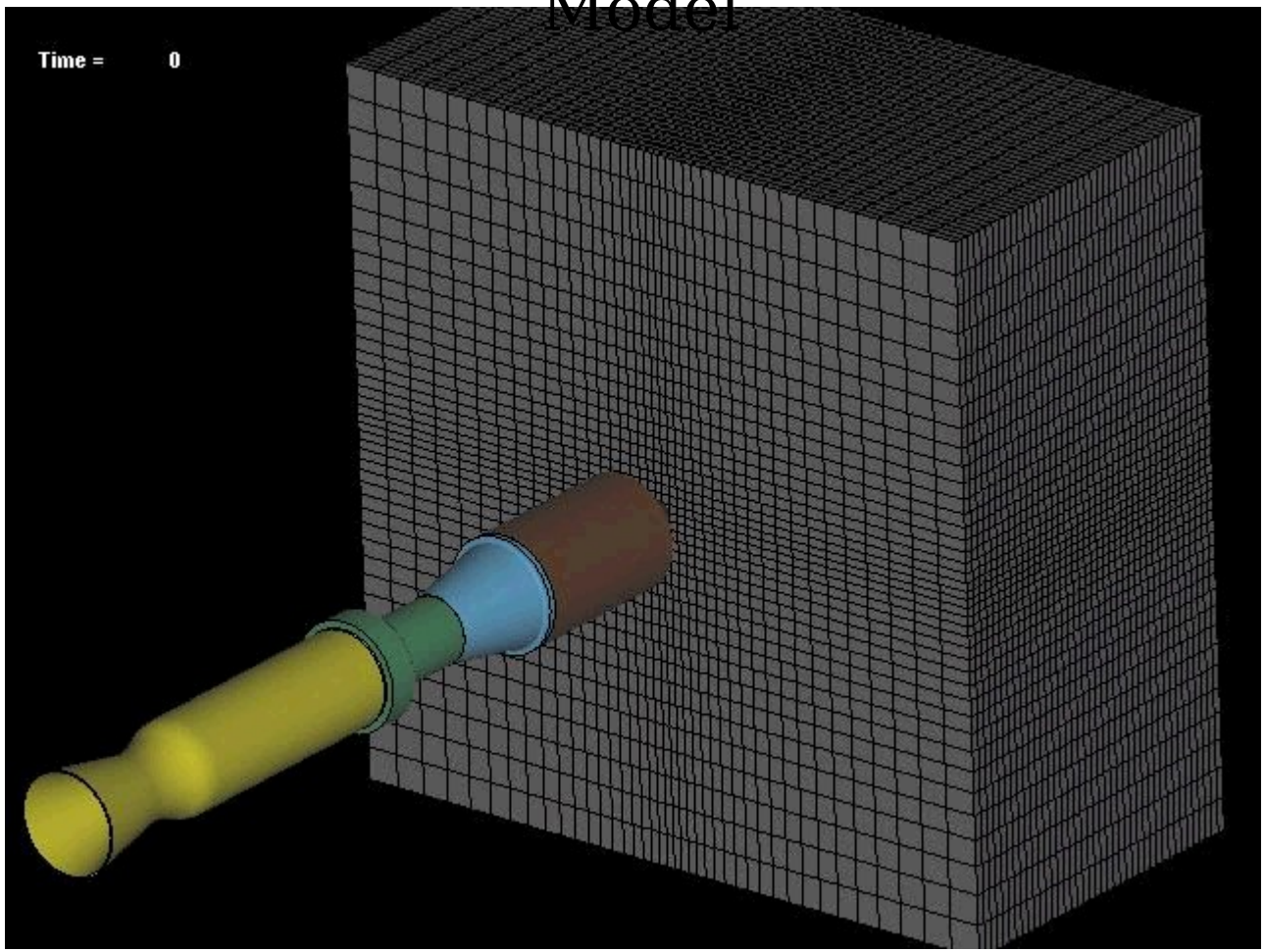
- Hydrocode Modeling
  - To Determine Warhead Geometry
  - To Determine Target Geometry
- Wall Impact Modeled with LS-DYNA
  - Hydrocode Capable of Solving Highly Transient Events, Including Detonation, Shock Waves and Fluid Interactions

Analytical Modeling

- Target Materials
  - Initial Evaluation with Sand, Concrete
  - Develop Brick Equations of State
  - Full Evaluation with Complete Target
    - Brick Over Plywood Sheet

Impact Analysis

Isometric View of Animated Wall Penetration Model

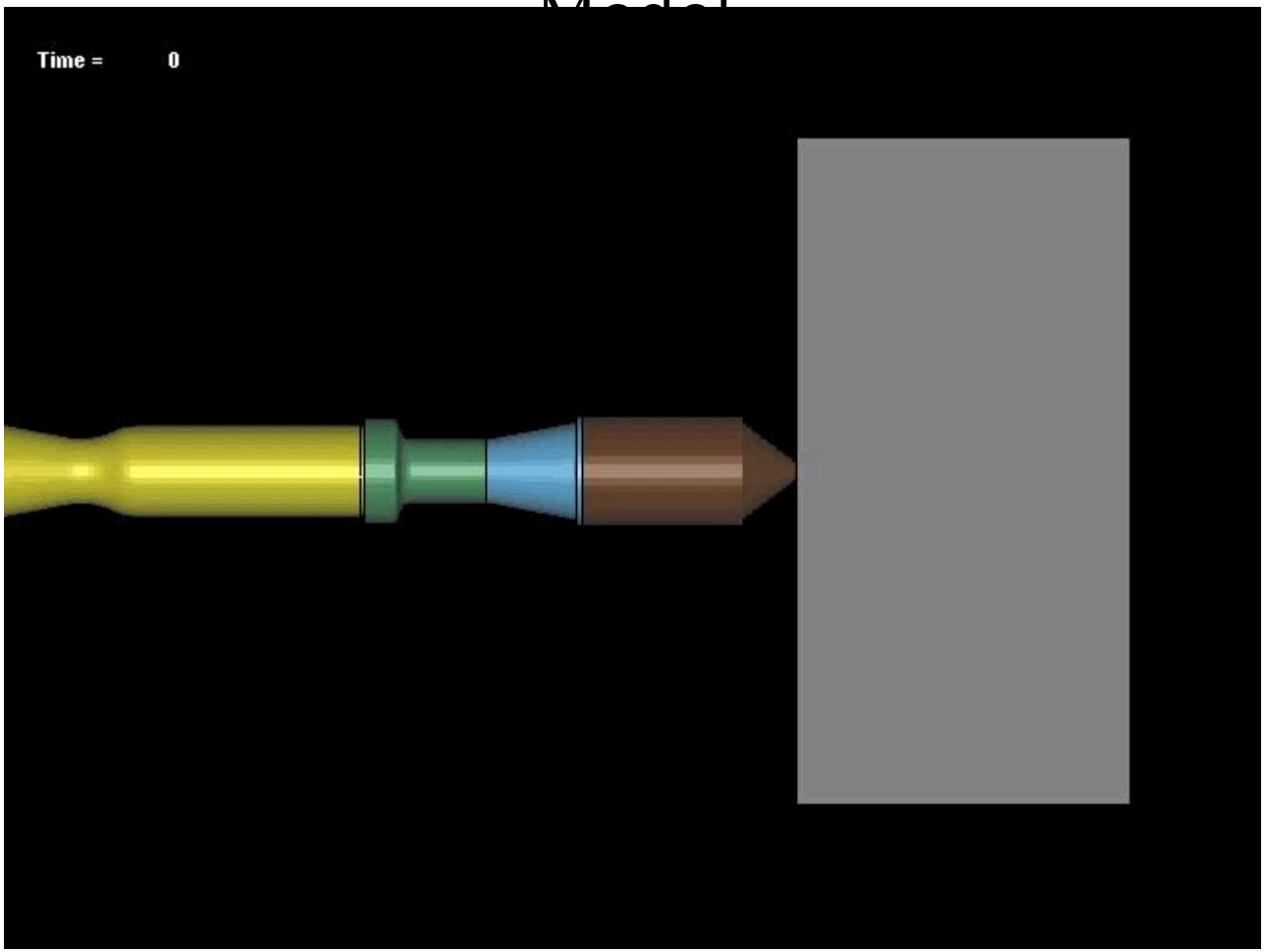


NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Impact Analysis

Side View of Animated Wall Penetration Model

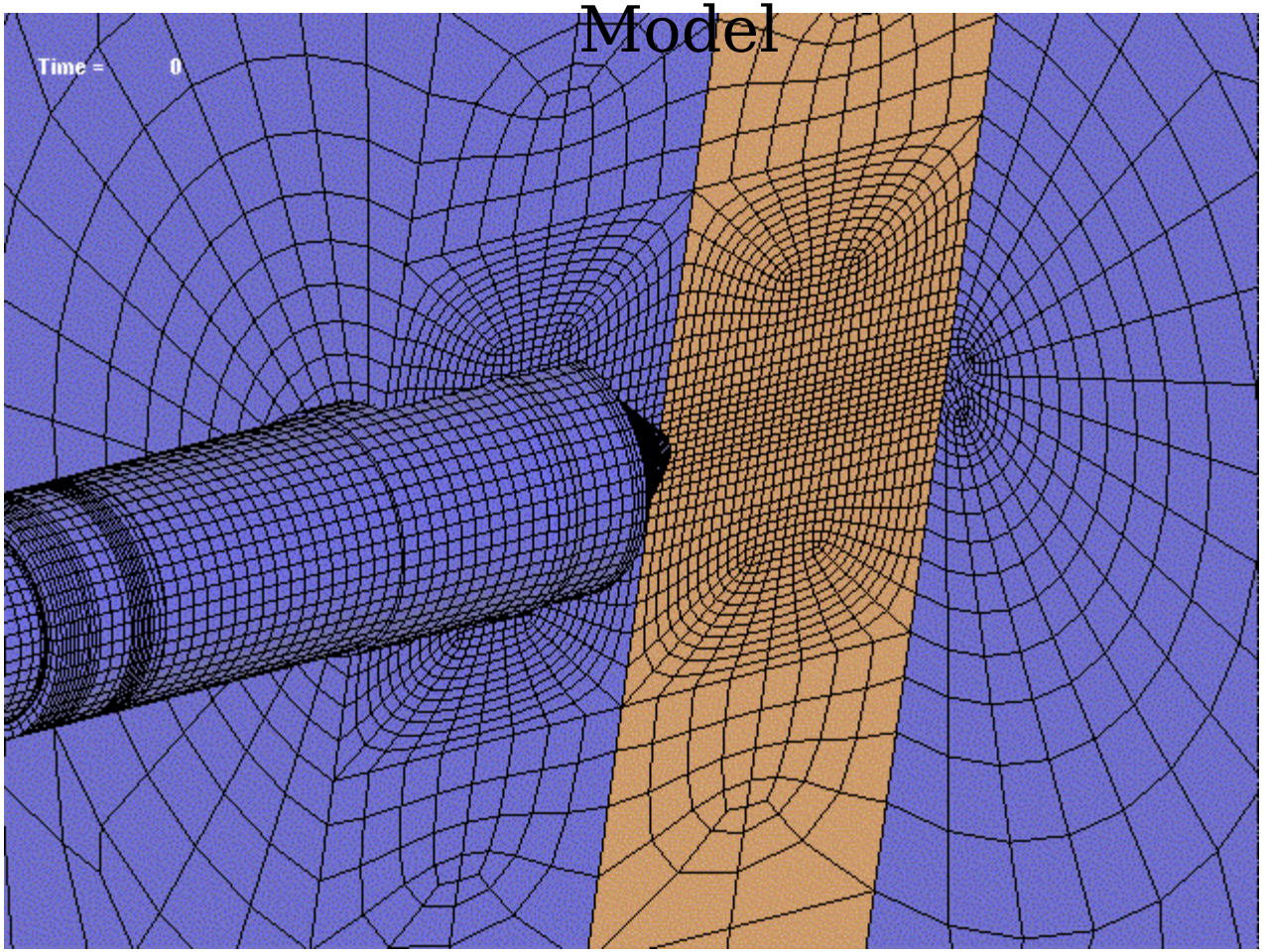


NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Impact Analysis

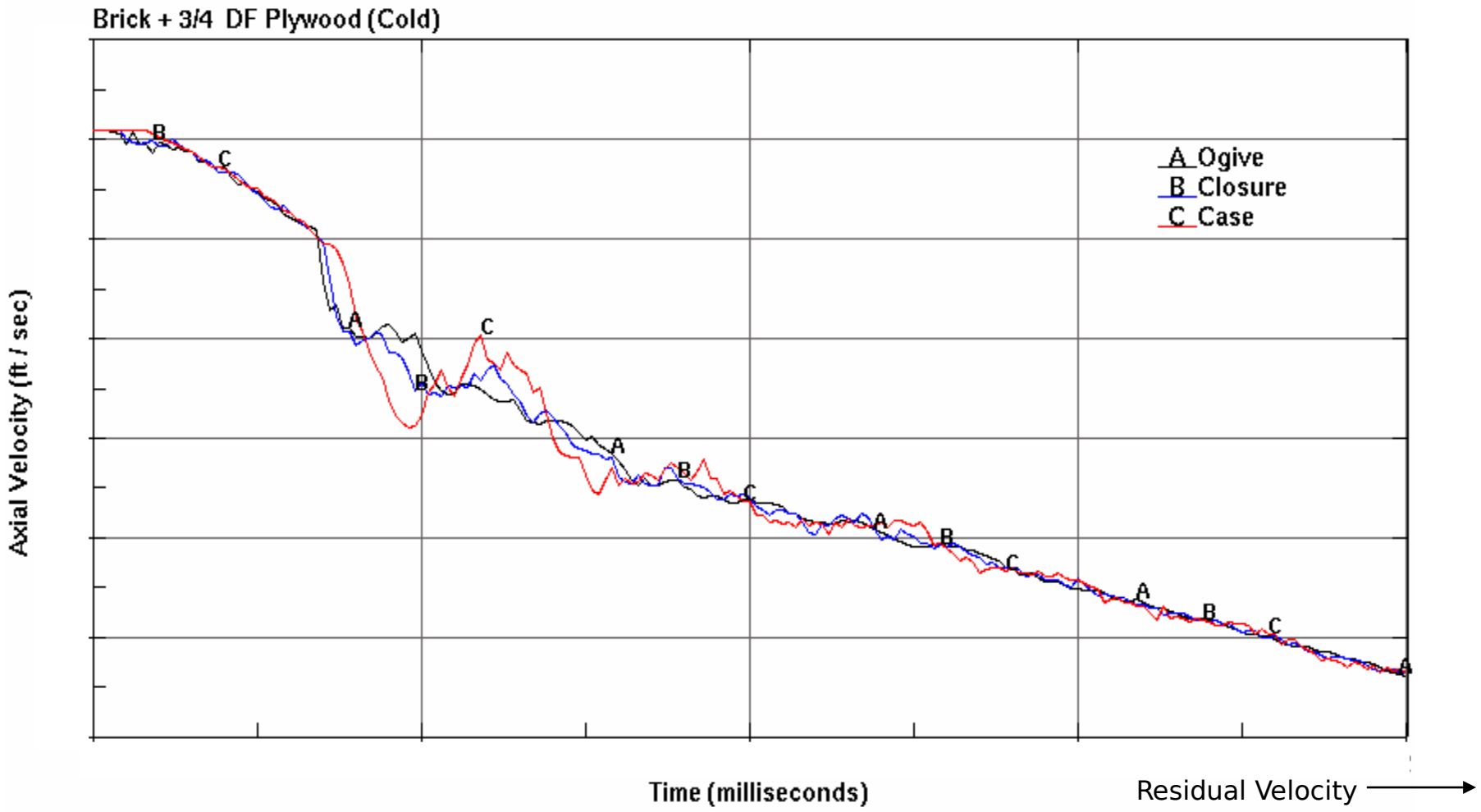
Internal View of Animated Wall Penetration Model



NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

V_{hist} Cold



NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Inert Warhead Tests

- Inert Impact Testing Conducted
  - To Evaluate Penetration Performance
  - To Evaluate Case Assembly Integrity
  - To Assess Residual Velocity Behind Wall
  - To Assess Fuze Function

Inert Penetration Testing

High Speed Video of Inert Warhead Penetrating Brick Wall

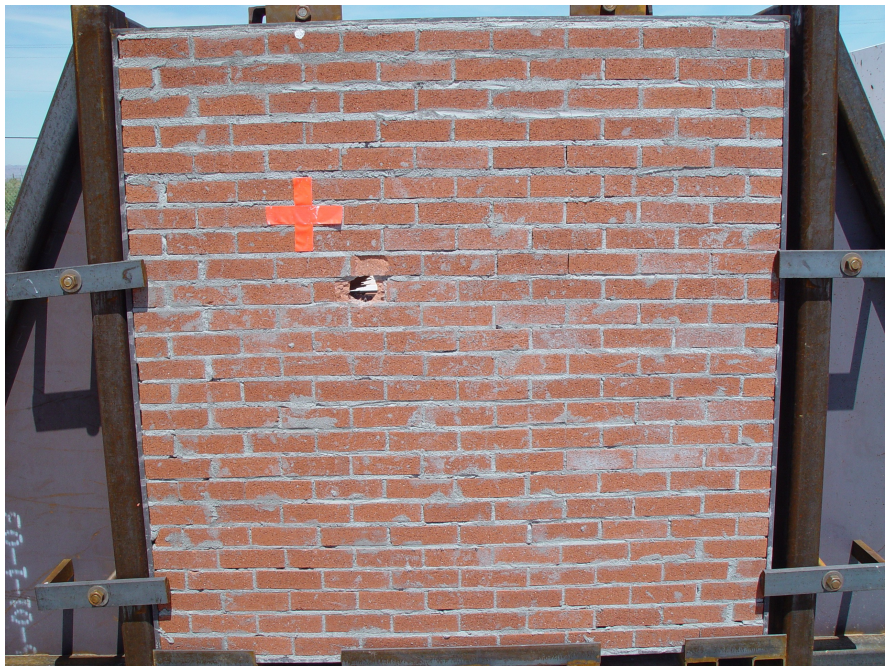
SK10945-1-E-004

Post-Test Round, Warhead Intact

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Typical Entry Hole



- E-004 Warhead Configuration
  - Exhibited Stable Flight
  - Warhead Case Penetrated Through Brick and Wood Sheeting
  - Warhead Maintained Positive Residual Velocity Behind Wall
  - Virgin Target, Fully Cured

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Live Warhead Testing

- Risk Reduction
  - All Up Round Dynamic Test
- Earth and Timber Bunker
  - Emplaced Live Warhead

Live AUR

High Speed Video of Live Warhead Penetrating Brick Wall

NAVSEA
INDIAN HEAD
Surface Warfare Center Division

Talley
Defense Systems

Live AUR

High Speed Video of Live Warhead Penetrating Brick Wall

NAVSEA
INDIAN HEAD
Surface Warfare Center Division

Talley
Defense Systems

Bunker

SK10945-1 E-013

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Customer Demonstration

- Demonstrated on Urban Brick Structure
  - Fired (1) Inert QE shot
  - Fired (1) All Up Round
- Demonstrated on Earth and Timber Bunker
  - Fired (1) All Up Round

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Camden Inert Brick

Urban Structure Firing Demonstration

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Camden Live Brick

Urban Structure Firing Demonstration

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Camden E&T Bunker

Earth and Timber Bunker Firing Demonstration

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems

Conclusions

- Multi-Purpose M72 NE (Novel Explosive) Fill
  - Increased Lethality with a Thermobaric Fill
  - Improved Insensitive Munition (IM) Potential
  - Penetrating Warhead Demonstrated
  - Demonstrated Fuze Hard/Soft Modes Individually
  - Uses Qualified Launcher/Propulsion System
  - Suitable for Future Fire From Enclosure (FFE) Application

NAVSEA INDIAN HEAD Surface Warfare Center Division

Talley Defense Systems